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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/766,148	01/27/2004	Yoshihide Senzaki	A-70028-2/MSS/TJH (463035	1972

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EXAMINER	
CAO, PHAT X	
ART UNIT	**PAPER NUMBER**
2814	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/10/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/766,148	SENZAKI, YOSHIHIDE	
	Examiner	Art Unit	
	Phat X. Cao	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 October 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Steigerwald et al (US. 6,479,404) in view of Hegde et al (US. 6,383,873).

Regarding claims 1 and 12, Steigerwald discloses a multilayer gate dielectric film (column 1, lines 61-63) comprising: a first layer formed of Zirconium oxide material (column 7, lines 57-59 and column 8, lines 5-9) having a dielectric constant k and thickness t, the zirconium oxide material having the formula of M(x)O(y) (i.e., ZrO(2)); a second layer formed on top of the first layer, wherein the second layer is formed of zirconium silicate material (column 7, lines 57-59 and column 8, lines 5-9) having a dielectric constant lower than that of the first layer of zirconium oxide material.

Steigerwald does not disclose that the second layer has a thickness smaller than the thickness of the first layer.

However, Hegde (Fig. 5) teaches a multilayer gate dielectric film comprising: a first layer 106 formed of a metal oxide material (column 2, lines 24-34) and having a thickness of 20-80 angstroms (column 2, lines 62-65); and a second layer 108 of a metal silicate material containing metallic element (column 3, lines 21-27) and formed on the first layer 106, the second layer 108 having a thickness in the range of one to two

atomic layers (column 4, lines 3-4). Accordingly, it would have been obvious to form the second layer having a thickness smaller than the thickness of the first layer because it is desirable to minimize the thickness of the second layer to maintain the high-k characteristics of the composite gate dielectric film, as taught by Hegde (column 3, lines 64-66).

Regarding claims 2-3, Steigerwald further discloses that the first layer of metal oxide and the second layer of metal silicate having a dielectric constant of at least about 10 (column 2, lines 51-54).

Regarding claims 4, 6-7 and 9, Steigerwald further discloses that the first layer is ZrO(2) and the second layer is ZrSiO(4) (column 7, lines 57-59).

Regarding claims 5 and 8, Steigerwald further discloses that the metal oxide first layer and the metal silicate second layer include more than one metal element (column 2, lines 51-57).

Regarding claims 10-11, Hegde further teaches that a first layer 106 of metal oxide having a thickness in a range of about 20-80 angstroms (column 2, lines 62-65), and the second layer 108 of metal silicate having a thickness in the range of about one to two atomic layers (column 4, lines 3-4).

Response to Arguments

3. Applicant argues that Steigerwald does not suggest "a first layer formed of a metal oxide material ... and a second layer formed atop the first layer wherein said layer if formed of a metal silicate material".

This argument is not persuasive because Steigerwald clearly states at column 1,

lines 61-63 that:

> "The gate dielectric is then formed on the substrate. The gate dielectric is either a metal oxide, a metal silicate or **both**";

and at column 8, lines 5-9:

> "The oxanorbornadiene catalyzes a reaction between itself and the inorganic precursors to deposit the **zirconium oxide/zirconium silicate film** on the surface of the semiconductor substrate without forming an addition SiO.sub2. layer."

From the above statements, Steigerwald clearly suggests the forming of a gate dielectric comprising a stack of first and second layers as claimed. The first layer if formed of a metal oxide material (ZrO), and the second layer is formed of a metal silicate material (ZrSiO).

Applicant further argues that it would not be obvious to combine Steigerwald with Hedge because the first layer 106 shown in Fig. 5 is not a metal oxide material.

This argument is not persuasive because Hedge clearly states at column 2, lines 55-58 that:

> "In an embodiment in which first oxide layer 106 includes a metal element and oxygen (**such as ZrO.sub.2**), the dielectric constant of first oxide layer 106 may be as high as 25."

Therefore, the first oxide layer 106 of Hedge is a metal oxide material because it contains metal (Zr) and oxygen(O).

Applicant also argues that a second oxide layer 108 formed on the first oxide layer 106 is not a metal silicate material because it has a metallic element content of less than approximately 0.09 atomic percent.

This argument is not persuasive because as taught by Steigerwald (primary reference) that the metal silicate dielectric is "the dielectric layer has the general structure (MO.sub.2).sub.x(SiO.sub.2).sub.y, where M is at least one metal, Si is silicon and O is oxygen, **x is about 0.05** to about 0.8 and y is about 0.95 to about 0.2 and the sum of x and y is 1" (column 8, lines 49-53). Therefore, the second oxide layer 108 of Hedge is a metal silicate dielectric because it contains silicon, oxygen and a metallic element of "approximately 0.09 atomic percent" which is more than 0.05 atomic percent (as taught by Steigerwald).

Conclusion

4. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phat X. Cao whose telephone number is 571-272-1703. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PC
January 4, 2007

PHAT X. CAO
PRIMARY EXAMINER